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ORIGINAL RESEARCH ARTICLE

Correlation and regression analysis of morphological traits in *Rumex dentatus*

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ABSTRACT: *Rumex dentatus* is an important crop plant weed and also serves as medicinal plant through out the world. Present study was conducted to access the genetic variability and association among morphological traits of *Rumex dentatus* under four different locations. The results indicated that the fresh plant weight was significant related with dry weight and moisture contents/percentage in *Rumex dentatus* plants. The location 3 serves as the best place for growth and development of *Rumex dentatus*. Hence, it was suggested that the growth and development of *Rumex dentatus* should be controlled through proper techniques to reduce yield losses in crop plants.

Keywords: *Rumex dentatus*, genetic analysis, correlation, regression, morphological traits, GGE biplot

INTRODUCTION

Worldwide, about 4 billion people today depend upon plants for drugs even in developed countries. Now a day, at least 25% of standard drugs recommended by a physician develop from folk medicines (Farnsworth, 1988; Marles and Farnsworth, 1995). Therefore, it is required to check traditional medicine with a view to exploit and identify effective and safe solutions for ailments of both non-microbial and microbial origin. *Rumex dentatus* (Plygonaceae) is mostly known as, Toothed Dock, Indian Dock and dentate dock. Usually Rumex plants are consumed as anti-inflammatory (Humeera et al., 2013; Vasas et al., 2015), bactericidal (Lee and Rhee, 2013), anti-dermatitis, astringent and antitumor (Litvinenko and MuzychKina, 2003) diuretic, laxative agents and cholagogue, tonic. Its extract is used for manufacturing of antibiotic, antioxidants and drugs, used as medicinal plant (Demirezer, 1993). Roots, stems and leaves of *Rumex usambarensis* L. *Rumex bequaertii* L. and *Rumex abyssinicus* L. are used to treat smallpox, stomach-ache, abscesses, cough and pneumonia (Midiwo et al., 2002). Plants have thousands of active biologically molecules. For their examination, it is necessary to have the important tools. These involved appropriate chemical screening and biological assays methods.

About 200 species broadly spread in South and North temperate zones; 27 species in china (Zhang et al., 2012) twelve species of Rumex occur in Texas (Tull, 2013). *Rumex acetosa*, *R. vesicarius, R. patient, R. alpestris, R. auriculatus, R. scutatus, R. aviculare, R. hastatus, R. lunaria, R. longifolius, R. montanus, R. polyanthemus, R. repens, R. thyrsifolius, R. tuberosus, R. acetosella*, grows in Africa: South Africa, Morocco, and Libya. Asia-Temperate: Stavropol, Kirghizistan, Israel, Kazakhstan, Republic of Georgia, Azerbaijan. Australasia: New Zealand. Asia-Tropical: India. Europe: Austria, Norway, Cyprus, Czechoslovakia, Denmark, Eire, Estonia, Faeroes, Finland, France, Germany, Italy, Poland, Romania, Russia, Serbia, Sweden, Switzerland, Ukraine, UK, Hungary,

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Yugoslavia (Oudhia, 2005). Whereas, in India various species of *Rumex* have been reported in chattisgarh, among all the species *Rumex vesicarius* is most popular. This paper is aimed to report the Morphological characters of *Rumex*.

General Morphology of herbs

Herbs are fewer usually annual or perennial, hardly dioecious, hardly shrubs. Roots are sometimes plants rhizomatous or usually stout. Erect stems, branched, ascending to prostrate, not sulcate or hollow. Simple leaves, cauline, alternate, persisting or fugacious, basal and often dimorphic, margin undulate or entire; membranous, ocrea tubular, margin entire. Inflorescence is commonly terminal, occasionally axillary and terminal, paniculate or racemose. Articulate pedicel (the operative pedicel comprises of the true pedicel and, under the joint, the narrowed combined basal parts of the outer petals). Flowers are unisexual or bisexual (unisexual hardly in polygamo-monoecious and in dioecious plants) (Bhargava and Sawhney, 1958; Joshi, 1936).

Morphological Description of *Rumex dentatus*

It is an annual herb, hardly biennial, erect stems, 30-70 cm long, grooved, branched from base; glabrous, branches ascending to almost divaricated. Lower leaves: petiole 3-5 cm; leaf blade narrowly elliptic to oblong, 4-12 × 1.5-3 cm, both surfaces papillose or glabrous, base rounded, along veins below, sub cordate, or truncate, margin slightly apex acute or obtuse, undulate; cauline leaves smaller; ocrea fugacious, membranous. Inflorescence is racemose, several racemes aggregated and panicle-like. Flowers are bisexual. Pedicel articulates below middle. Outer tepals elliptic, ca. 2 mm; inner petals enlarged in fruit; valves triangular ovate, 4-5 × 2.5-3 mm, allvalves with tubercles 1.5-2 mm, conspicuously net veined, base rounded, each margin with 2-4 teeth, apex acute to subacute; teeth 1.5-2 mm. Achenes yellow-brown, shiny, ovoid, sharply trigonous, 2-2.5 mm, base narrow, apex acute (Bhargava and Sawhney, 1958; Joshi, 1936).

MATERIALS AND METHODS

Collection of the plant material

The plant material *Rumex dentatus* was collected from the 4 different locations of Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan. The whole plant material was kept under shade for drying.

Data taking

The data was recorded for fresh plant weight, dry plant weight, by using an electronic balance (OHAUS-GT4000, USA), total plant moisture percentage [(fresh plant weight – dry plant weight)/fresh plant weight*100], leaf area and plant height. The data was statistically analyzed by using analysis of variance technique (Steel and Torrie, 1997).

RESULTS AND DISCUSSIONS

The results (Table 1) revealed that significant differences were recorded among the locations under study for *Rumex dentatus*. It was found that average fresh weight of plant was recorded as 5.101±0.1012g, plant height (22.179±1.2011cm), leaf area (28.948±0.1082cm^2), fresh inflorescence weight (4.074±1.0121g), dry plant weight (0.588±0.0047g) and moisture content percentage (88.483±2.67%). The coefficient of variation was found to be lower for all studied traits. The higher plant fresh weight indicated that the *Rumex dentatus* plants have ability to withstand under variable environmental conditions. The higher moisture percentage justified it that the plants can tolerate harsh, hot and dry climate conditions. The *Rumex dentatus* plants can survive under water deficit conditions indicated that it can compete with crop plants for water, minerals nutrients and space which in results for low crop plant yield and productions. It usually grows in wheat, maize, barley, sugarcane and chickpea crop growing

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filed due to which the yield of grain crops is highly affected (Anjum and Bajwa, 2010; Zameer et al., 2015). It should be controlled through chemical, crop plant leaf extracts and manual ways to reduce its hazards for crop plants (Anjum and Bajwa, 2007).

Table 1. Analysis of variance for morphological traits of *Rumex dentatus*

SOV	FW	PH	LA	FlW	DW	MC
Locations	0.567*	6.743*	0.652*	8.241*	9.015*	23.2092*
Error	0.052	0.102	0.0412	0.2015	2.0891	1.082
Grand Mean	5.101	22.179	28.948	4.074	0.588	88.483
Standard Error	0.1012	1.2011	0.1082	1.0121	0.0047	2.4013
CV	3.105	4.032	3.02	2.05	1.64	2.67

*=Significant at 5% probability level, PH = Plant height, FW = Fresh weight, LA = Leaf area, FIW = Fresh inflorescence Weight, DW = Dry weight, MC = Moisture contents

It was persuaded form table 2 that significant and strong correlation was found between fresh plant weight and fresh inflorescence weight, fresh plant weight and dry plant weight, leaf area and dry weight, dry weight and fresh inflorescence weight while significant and negative correlation was found between fresh plant weight and plant height, fresh inflorescence weight and plant height, moisture contents/percentage and plant height, leaf area and moisture contents/percentage, moisture contents/percentage and dry weight of plant. The positive correlation revealed the traits are highly associated with each other and caused survival ability improvement in crop plants (Ali et al., 2012; Harrem et al., 2015; Mobeen et al., 2015).

Table 2. Correlation among morphological traits of *Rumex dentatus*

Traits	FW	PH	LA	FIW	DW
PH	-0.3557*				
LA	0.1881	0.1598			
FIW	0.9547*	-0.3925*	-0.0167		
DW	0.7002*	0.1128	0.5094*	0.666*	
MC	-0.0122	-0.5198*	-0.4606*	-0.0248	-0.7195*

*=Significant at 5% probability level, PH = Plant height, FW = Fresh weight, LA = Leaf area, FIW = Fresh inflorescence Weight, DW = Dry weight, MC = Moisture contents

Regression analysis was performed to evaluate the highly contributing traits for fresh plant weight. It was found from results that dry weight (9.106) was the highly contributing traits towards fresh plant weight followed by moisture contents/percentage (0.424) and plant height (0.003) while leaf area and fresh inflorescence weight were negatively contributing traits towards fresh plant weight (Table 3). The regression equation was predicted as, Y (FW) = -36.606 + 0.003(PH) – 0.04(LA) – 0.008(FIW) + 9.106(DW) + 0.424(MC)

It was found from figure 1 that PC1 contributed 80.3% and PC2 12.7% variation for studied traits under four different locations. The location 3 showed the best one place for growth and development of *Rumex dentatus* plants while the place 4 showed the harsh place for it. The location that showed favourable environmental condition for better plant growth indicated that the soil fertility is higher with good moisture and nutrient availability. The plant population at location 3 should be controlled by specific weed management technologies while the use of transgenic crops may be an advantage to compete with *Rumex dentatus* plants (Qamar et al., 2015).

Table 3. Stepwise multiple linear regression for fresh weight of *Rumex dentatus*

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Traits	Coefficients	Standard Error	t Stat	Partial R^2	Lower 95%	Upper 95%
PH	0.003	0.002	1.246	25.9	-0.003	0.008
LA	-0.04	0.012	-3.408	21.42	-0.069	-0.011
FIW	-0.008	0.026	-0.324	30.57	-0.071	0.055
DW	9.106	0.688	13.238	14.24	7.423	10.79
MC	0.424	0.027	15.573	10.23	0.358	0.491

Intercept = -36.606, standard error = 0.0186, Multiple R^2 = 99.95%, R^2 = 99.90%, Adjust R^2 = 99.82%

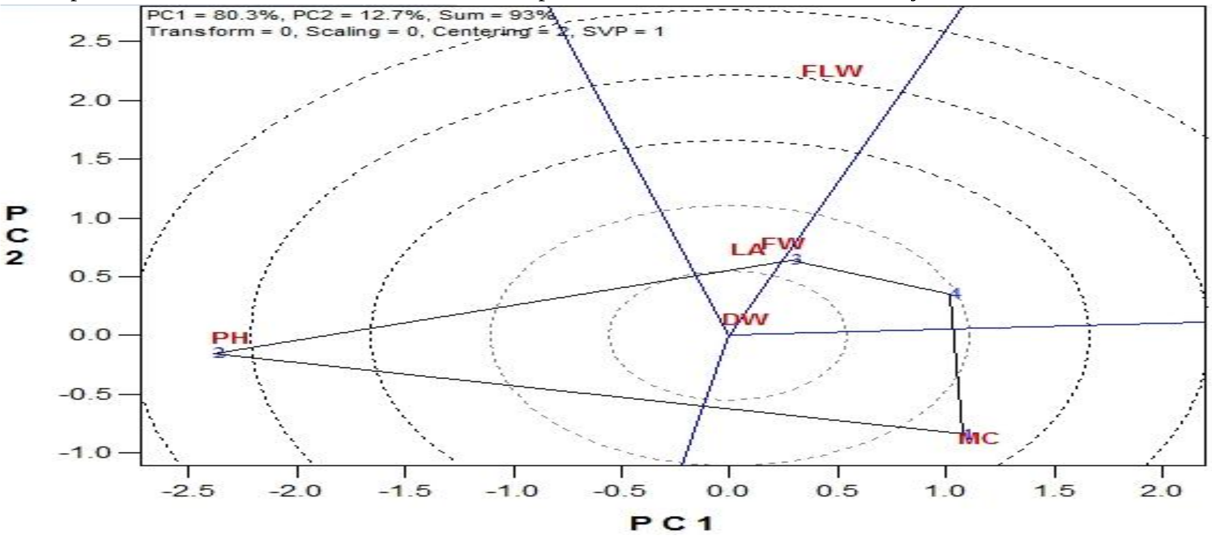

Figure 1. GGE biplot for morphological traits of *Rumex dentatus* under 4 different locations

CONCLUSIONS

The present study indicated that the fresh plant weight was significant related with dry weight and moisture contents/percentage in *Rumex dentatus* plants. The location 3 serves as the best place for growth and development of *Rumex dentatus*. Hence, it was suggested that the growth and development of *Rumex dentatus* should be controlled through proper techniques to reduce yield losses in crop plants.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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